Claims

What is claimed is:

1. An apparatus that provides at least one estimated effective age of a product, comprising:

at least one sensor that provides data about an environmental condition;

a device that uses said data to calculate an age acceleration factor for said product for at least one of said sensors;

at least one accumulator that provides the estimated effective age for said product, based upon said age acceleration factor; and

a display capable of presenting said estimated effective age to a user of said product.

2. The apparatus of claim 1, wherein said sensor includes an analog to digital conversion function, and wherein said device that uses said data to calculate an age acceleration factor is a digital processor.

3. The apparatus of claim 2, wherein said digital processor is programmed to compute an Arrhenius estimate of said age acceleration.

4. The apparatus of claim 2, wherein said digital processor is programmed to compute a Coffin-Manson estimate of age acceleration.

5. The apparatus of claim 2, wherein said digital processor is programmed to compute a Hallberg-Peck estimate of age acceleration.

6. The apparatus of claim 2, wherein said accumulator is at least partially implemented in nonvolatile storage.

7. The apparatus of claim 6, wherein said nonvolatile storage is a ferroelectric memory.

8. The apparatus of claim 6, wherein said nonvolatile storage is a flash memory.

9. The apparatus of claim 6, wherein said nonvolatile storage is a hard disk.

10. The apparatus of claim 6, wherein said nonvolatile storage is a volatile memory element, with continuity of power provided by a battery.

11. The apparatus of claim 1, wherein said sensor produces an analog voltage output, said analog voltage output varying substantially linearly responsive to a change in temperature.

12. The apparatus of claim 11, wherein said device that uses said data to calculate an age acceleration factor for said product is a VCO, said VCO producing a VCO output signal that varies substantially exponentially responsive to a linear voltage change on an input of the VCO.

13. The apparatus of claim 12, wherein said accumulator is a counter; said counter being implemented, at least in part, in a nonvolatile or effectively nonvolatile technology.

14. The apparatus of claim 13, wherein said display is electrically coupled to selected bits of said counter.

15. A method for producing one or more estimates of effective age of a product, comprising the st ps of:

sensing one or more environmental conditions;

computing an age acceleration factor for each of the environmental conditions sensed, using a model that relates the environmental condition to the age acceleration factor;

computing effective age values, using said acceleration factors;

storing said effective age values into nonvolatile storage; and

displaying said effective age values to a user of said product on a display.

16. The method of claim 15, wherein the step of computing an age acceleration factor comprises the use of the Arrhenius equation, the Hallberg-Peck equation, or the Coffin-Manson equation.

17. The method of claim 15, wherein the step of computing effective age values further comprises the steps of:

time integrating the age acceleration factor for each of the environmental conditions sensed, resulting in an effective age for the product according to each said model;

computing a normalized effective age for some or all of the effective ages by dividing the instant effective age by a wall clock age;

computing an effective life used value for some or all of the effective ages by dividing the instant effective age by a predetermined estimate of life of the product; and

computing an effective life remaining value for some or all of the effectiv ag s by subtracting said eff ctive life used value from "1".

18. The method of claim 15, wherein the step of displaying said effective age values further comprises the steps of:

determining if any of said values are outside of predetermined ranges; and

alerting the user if any of said values are outside of predetermined ranges by lighting a light, sounding an audible alarm, or presenting said values on said display